Air Toxics Sampling in Kentucky

Environmental and Public Protection Cabinet
Department for Environmental Protection

Prepared by Larry Garrison
Manager, Technical Services Branch
Kentucky Division for Air Quality
December 2, 2004

What are Air Toxics?

EPA defines air toxics as any air pollutant (other than the criteria pollutants) that has the potential to cause adverse impacts to human health or the environment.

EPA's Toxic Substance Control Act (TSCA) Inventory has over 75,000 chemicals listed many of which can be air toxics

Section 313 Toxics Release Inventory has 677 chemicals listed most of which can be air toxics

Hazardous **A**ir **P**ollutants

HAPS are pollutants or groups of pollutants that EPA knows or suspects to cause cancer or other serious human health effects or to have adverse environmental effects.

Section 112(b) of the Clean Air Act initially listed 188 **H**azardous **A**ir **P**ollutant**s** targeted by EPA for reductions in releases to air

The 188 **HAPS** are sometimes referred to as "the regulated air toxics"

Persistant Bioaccumulative HAPs

- Easily transfers between air, water, and land
- Can linger for generations
- Potential to be transported from long distances
- Most common are Mercury, PCBs, dioxins, DDT, and chlordane
- Indirect Exposure Pathway (contact occurs in a medium that is not the original medium to which the chemical was released)
- Can be Multi-pathway

Secondary Air Toxics

- Formed as a result of chemical reactions
- In some cases the pollutant that is formed is more toxic and/or more persistent than the chemicals that were originally released
- Examples 1,3-butadiene →acrolein, carbon disulfide→carbonyl sulfide, nitric acid and chlorinated organics→hydrogen chloride, ethene and propene→formaldehyde.

Categories

- Volatile Organic Compounds

  Benzene, Toluene, Vinyl Chloride, 1-3 Butadiene

- Carbonyl Compounds (Subset of VOCS)

  Formaldehyde, Acetaldehyde

- Semi-Volatile Organic Compounds

  Polycyclic Organic Matter (POM), Dioxins/Furans

- Inorganics

  Metals, Halogens, Inorganic Bases, Inorganic Acids

How are people exposed to air toxics?

- Breathing contaminated air
- Eating food products that have been contaminated by deposited air toxics
- Drinking water contaminated by air toxics
- Ingesting contaminated soil
- Touching contaminated soil, dust, or water

Sources

- Industrial
  - Combustion, Solvents, Processes
- Mobile
  - Incomplete Combustion, Fuel/Fluids/Additives, Secondary Formation
- Indoor
  - Building Materials, Combustion, Cleaning Products, Environmental Tobacco Smoke (ETS), Personal Care Products, Pesticides
- Natural
  - Geological, Biogenic, Marine

Utilities

Typical HAPS emissions include:

Arsenic Compounds	Cadmium Compounds	Chromium Compounds
Hydrochloric Acid	Hydrogen Fluoride	Lead Compounds
Manganese Compounds	Mercury Compounds	Nickel Compounds

List of Mobile Source Air Toxics (MSATS)

Acetaldehyde	Diesel Particulate Matter+Diesel Exhaust Organic Gases	MTBE
Acrolein	Ethylbenzene	Naphthalene
Arsenic Compounds	Formaldehyde	Nickel Compounds
Benzene	N-Hexane	Polycyclic Organic Matter (POM)
1,3 Butadiene	Lead Compounds	Styrene
Chromium Compounds	Manganese Compounds	Toluene
Dioxins/Furans	Mercury Compounds	Xylene

HAPS in ETS

1,3 Butadiene	Acetaldehyde	Acetonitrile	Acrolein
Benzene	Carbonyl Sulfide	Ethyl Benzene	Formaldehyde
Hydrazine	Methanol	Methyl Chloride	N-Nitrosodimethylamine
Nickel	Styrene	Toluene	Phenol
4-Aminobiphenyl	Aniline	Arsenic	Quinoline
Lead	Cadmium	Catechol	Chromium VI
Hyrdoquinone			

EPA Office of Health and Environmental Assessment

Respiratory Health Effects of Passive Smoking

Lung Cancer and Other Disorders

Air Toxics from Geological, Biogenic, and Marine Sources

Sulfuric Acid	Hydrofluoric Acid	Hydrochloric Acid
Radon	Ammonia	Dimethyl sulfide
VOCs	Chlorides	Sulfates
Methane	Alkyl halides	Nitrous oxides

Goal of Sampling

- To address the concerns posed by air toxics emissions by:
  - Characterizing ambient levels
  - Prioritizing the focus of programs
  - Addressing the impact on public health and the environment

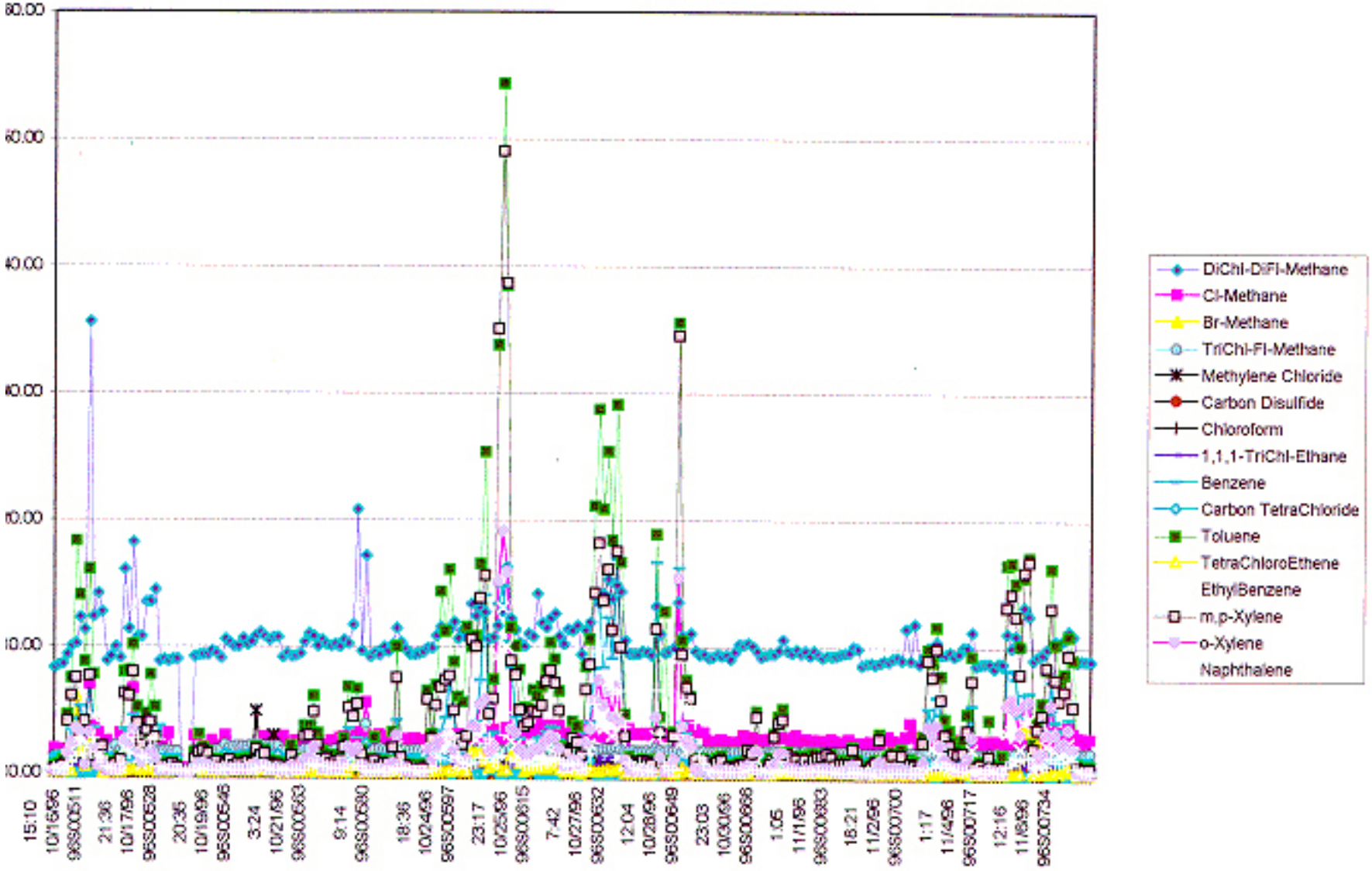
Challenges

- 34 different sampling methods (17 for Organics, 17 for Inorganics)
- Typically requires laboratory support
- Measurement of very low levels and therefore potential of contamination of samples is increased
- Detection Limits may not be at risk levels
- Produces a large dataset with few analytical tools
- Very labor intensive and expensive


EARTH DAY 1995


FLAMMABLE
KEEP FIRE AWAY

Selected VOC's Kenova Volunteer Fire Station 16 OCT -7 NOV 96



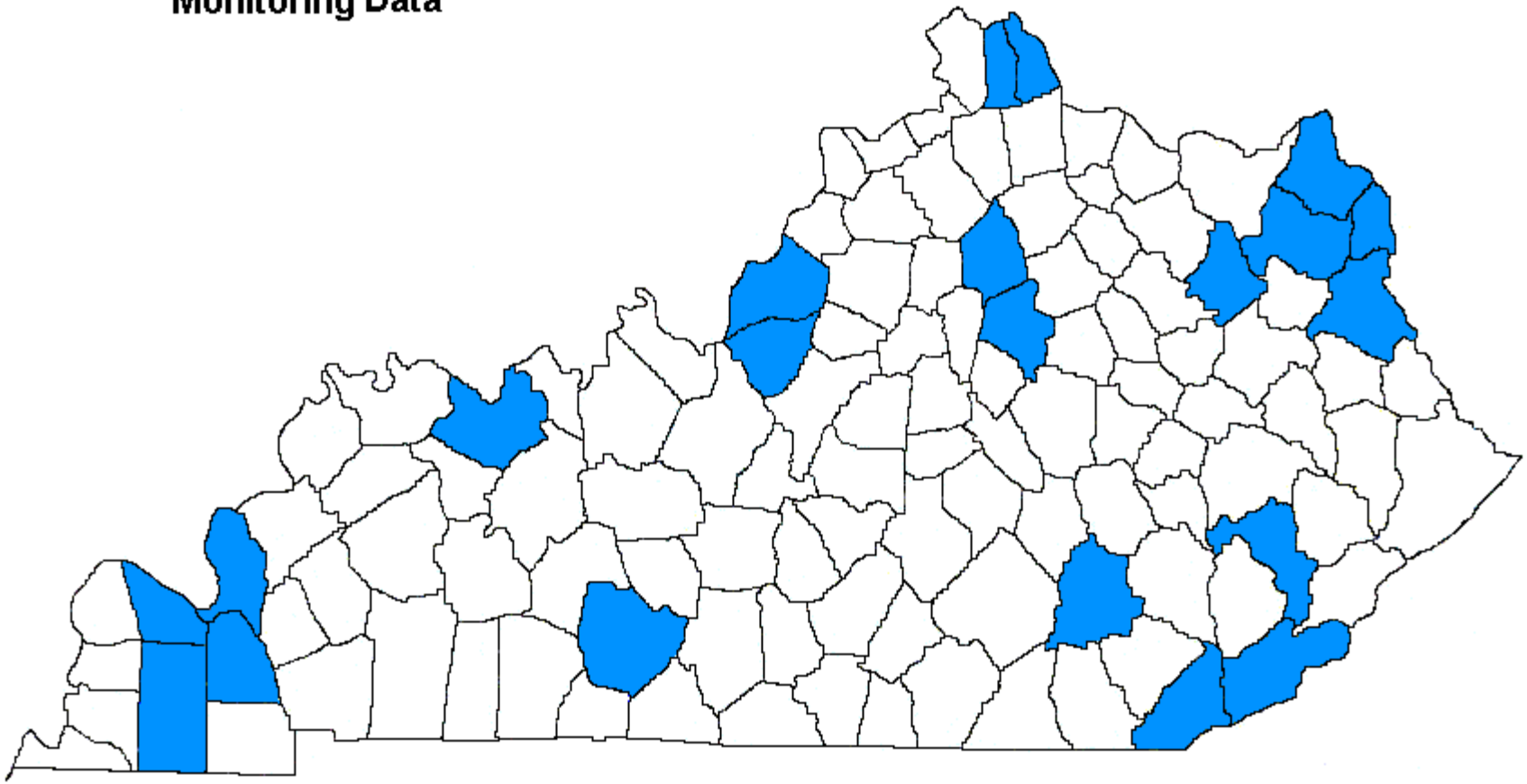
16 Compounds CONTRUN1

11/12/98

Historical Sampling In Kentucky

- First air toxics sampling was at National Electric Coil site in Harlan County in 1989
- Since that time we have taken approximately 10,500 samples
- We have sampled for volatile organics, semi-volatile organics, metals, dioxin/furans, PCBs, carbonyls, and acidic/basic gases
- Focus has been on “Hot Spots” and urban areas

Counties with Air Toxics Monitoring Data



Major Initiatives

- Calvert City Geographic Initiative (1991-1998)
- Tri-State Geographic Initiative Kenova cluster (1996-1997)
- Tri-State Geographic Initiative Greenup cluster (1999-2000)
- Urban Trends Study (2000-2002)
- West Louisville Air Toxics Study (2000-2001)

Calvert City Geographic Initiative

- Multimedia Study for the Calvert City Industrial Complex and surrounding areas
  - KY Department for Environmental Protection
  - KY Cabinet for Health Services
  - KY Fish and Wildlife
  - U.S. Geological Survey
  - University of Kentucky
  - Agency for Toxic Substances and Disease Registry (ATSDR)
  - U.S. EPA Region 4

Calvert City Geographic Initiative

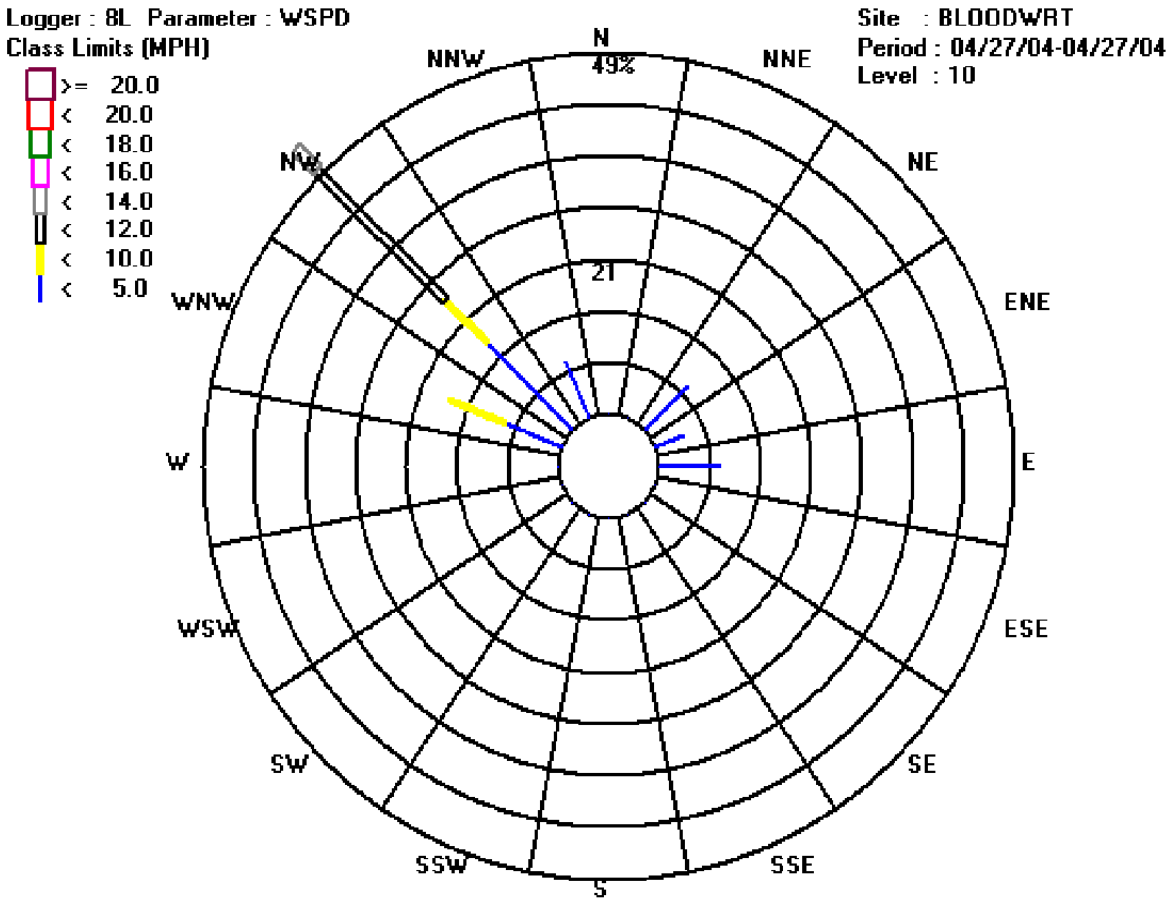
- Purpose was to evaluate the potential health risks associated with the entire complex
- Was initiated in response to requests by residents, citizen groups and workers
- December 14, 1999 Comprehensive Risk Evaluation by DES Risk Assessment Branch
- The maximum impact site was left in place to track progress and provide data to address concerns

Calvert City "Recent" Activities

- Added 2 new sites in 2002
- July-August 2002 performed saturation study with sampling frequency every day
- August 2002 Departmental evaluation of Vinyl Chloride and EDC sources
- November 2002-April 2003 inter-lab study with EPA
- January 2004 added an additional site and set sampling frequency at 1-in-6 day sampling

Sample Date 04/27/04

	Vinyl Chloride µg/m³	1,2 Dichloroethane µg/m³
Bloodworth	not detected	not detected
Bloodworth Duplicate	no sample	no sample
Johnson Plumbing	not detected	not detected
TVA Substation	not detected	10.85
Atmos Energy	not detected	not detected



Precipitation 0.00 in.
Average Temp 54 F

Tri-State Geographic Initiative

- Multimedia Study for the Tri-State area of Kentucky, West Virginia, and Ohio
  - KY Department for Environmental Protection
  - WVA Division of Environmental Protection
  - Ohio Environmental Protection Agency
  - Portsmouth (Ohio) Local Agency
  - U.S. EPA Regions 3, 4 and 5
  - Ohio River Valley Water Sanitation Commission (ORSANCO)
  - Agency for Toxic Substances and Disease Registry(ATSDR)

Tri-State Geographic Initiative

- Purpose was to evaluate the potential health risks in the Tri-State Region where Kentucky, Ohio, and West Virginia meet
  - Greenup and Boyd Counties in KY
  - Lawrence and Scioto Counties in OH
  - Wayne and Cabell Counties in WVA
  - Approximately 368,000 citizens within 2,300 sq miles

Tri-State Geographic Initiative

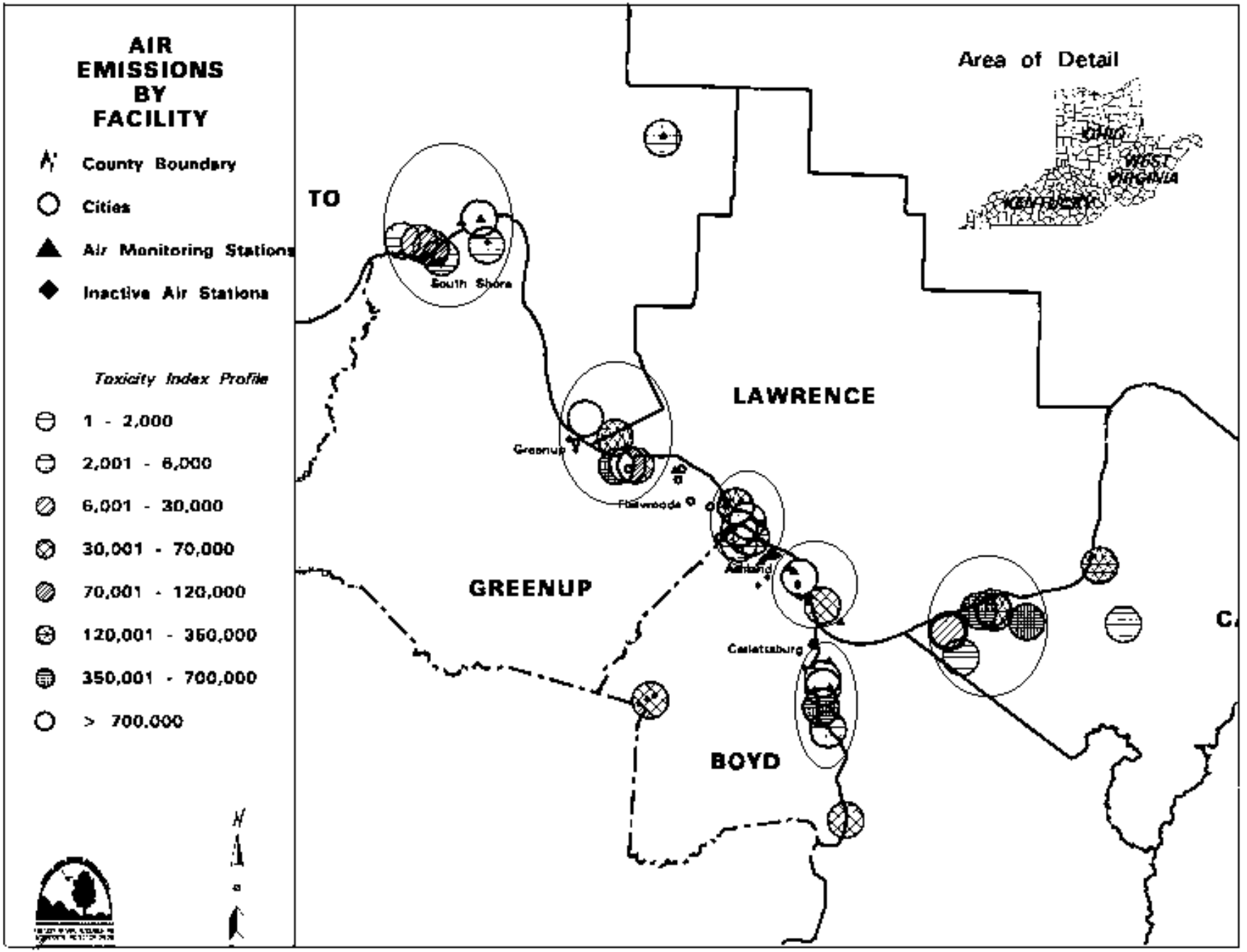
Initiated due to high risk/priority indicators

1. Pollutants released into the environment
2. Potential human health effects
3. Known/suspected environmental problems
4. Region's meteorological conditions
5. Level of public concern
6. Environmental equity

Tri-State Geographic Initiative

The size of the area in question required that it be divided into 6 “Industrial Clusters” that were ranked by a risk screening process

1. Kenova Cluster
2. Greenup Cluster
3. Ironton Cluster
4. South Point Cluster
5. Huntington Cluster
6. Portsmouth Cluster


AIR EMISSIONS BY FACILITY
County Boundary
Cities
Air Monitoring Stations
Inactive Air Stations
Toxicity Index Profile
1 - 2,000
2,001 - 6,000
6,001 - 30,000
30,001 - 70,000
70,001 - 120,000
120,001 - 350,000
350,001 - 700,000
> 700,000
Area of Detail
OHIO
WEST VIRGINIA
KENTUCKY
TO
South Shore
LAWRENCE
Greenup
Flatwoods
Ashland
GREENUP
Catlettsburg
BOYD
C

Tri-State Geographic Initiative

- Kenova Cluster
  - Sampling 1996-1997
  - 7 monitoring stations (3 in KY, 4 in WVA)
  - 32 monitors/samplers + mobile laboratory
  - 166 pollutants
- Greenup Cluster
  - Sampling 1999-2000
  - 7 sampling stations (4 in KY, 3 in Ohio)
  - 32 monitors/samplers + mobile laboratory
  - 166 pollutants

Urban Trends Study

2000-2002 to characterize ambient levels of air toxics in the urban environment

- Lexington
- Covington
- Owensboro
- Paducah
- Ashland
- Shepherdsville
- Bowling Green

West Louisville Air Toxics Study

- Primary objective was to determine if residents in the neighborhoods of the West Louisville area were being exposed to airborne concentrations of hazardous air pollutants that may pose unacceptable health risks
- The study area included 12 neighborhoods with approximately 70,000 residents
- Dense concentration of industry

West Louisville Air Toxics Study

- West Jefferson County Community Task Force
- Jefferson County Air Pollution Control District
- U.S. EPA Region 4
- KY Institute for the Environment and Sustainable Development
- The University of Louisville Air Quality Laboratory
- Kentucky Pollution Prevention Center
- KY Department for Environmental Protection

Other Studies

- Brooks Elementary School 1992
- Franklin County Tire Fire 1996
- Fort Wright/Taylor Mill 1998
- Boyle County Rail Car Fire 2000
- Georgetown 2001
- Owingsville BP Station 2002

Fort Wright/Taylor Mill Study

- Study was conducted in response to numerous citizen complaints of odors
- Focus was in the area surrounding the Interplastics Corporation Silmar Resins
- Grab and 24-hour samples taken in 1996
- Mobile Lab deployment July-August 1998
- Volatile Organic Compounds were targeted

Georgetown Study

- Study was conducted in response to numerous citizen complaints
- Focus was in the area surrounding Toyota Manufacturing
- Mobile lab deployment May-June 2001
- Volatile Organic Compounds were targeted

National Air Toxics Trends Assessment (NATA)

- Used emissions data and monitoring data to look at air toxics on a national scale
- Assessment used 33 HAPS identified as those of most concern
  - Estimated concentrations
  - Estimated population exposure
  - Characterized potential health effects including cancer and non-cancer effects

National and Regional Air Toxics Risk Drivers

National cancer risk drivers	benzene, chromium, formaldehyde
Regional cancer risk drivers	arsenic, coke oven emissions, 1,3 butadiene, polycyclic organic matter (POM)
Important national cancer risk contributors	nickel, acetaldehyde, carbon tetrachloride, chloroform, ethylene dibromide, ethylene dichloride, perchloroethylene, polycyclic organic matter (POM)
Important regional cancer risk contributors	acrylonitrile, beryllium, cadmium, ethylene oxide, 1,3 dichloropropene, hydrazine, trichloroethylene, quinoline, 1,1,2,2 tetrachloroethane
National noncancer hazard drivers	acrolein
Regional noncancer hazard drivers	acetaldehyde, arsenic, 1,3 butadiene, formaldehyde, manganese

List of 33 Urban Air Toxics HAPs

VOCs	Metals (Inorganic Compounds)	Aldehydes (Carbonyl Compounds)	SVOCs and other HAPs
acrylonitrile	arsenic compounds	acetaldehyde	2,3,7,8-tetrachlorodibenzo-p-dioxin (& congeners & TCDF congeners)
benzene	beryllium and compounds	formaldehyde	coke oven emissions
1,3-butadiene	cadmium compounds	acrolein	hexachlorobenzene
carbon tetrachloride	chromium compounds		hydrazine
chloroform	lead compounds		polycyclic organic matter (POM)
1,2 -dibromoethane (ethylene dibromide)	manganese compounds		polychlorinated biphenyls (PCBs)
1,3-dichloropropene	mercury compounds		quinoline
1,2-dichloropropene (propylene dichloride)	nickel compounds		
ethylene dichloride (1,2-dichlorethane)			
ethylene oxide			
methylene chloride (dichloromethane)			
1,1,2,2,-Tetrachloroethane			
tetrachloroethylene (perchloroethylene)			
trichloroethylene			
vinyl chloride			

National Air Toxics Trends Program

- To refine monitoring approaches
- To provide data to allow determination of Data Quality Objectives (DQOs)
- To characterize, prioritize, and address the impacts of HAPS on the public health and the environment

National Air Toxics Trends Program

- 22 sites nationally
- 15 Urban and 7 Rural
- 100% Federally Funded
- Focuses on the 33 Hazardous Air Pollutants used in NATA

List of NATTS Sites

Region	Urban	Rural
I	Providence, RI	Chittenden, VT
	Roxbury, MA	
II	New York City, NY Rochester, NY	
III	Washington DC	
IV	Atlanta, GA Tampa, FL	Hazard County, KY Chesterfield, SC
V	Detroit, MI Northbrook, IL	Mayville, WI
VI	Houston, TX	Harrison County, TX
VII	St. Louis, MO	
VIII	Bountiful, UT	Grand Junction, CO
IX	San Jose, CA Phoenix, AZ	
X	Seattle, WA	La Grande, OR

NATTS Site Perry County Horse Park

Parameters:

Metals

VOCS

Aldehydes

PM2.5

PM2.5 Speciation

PM10

Ozone

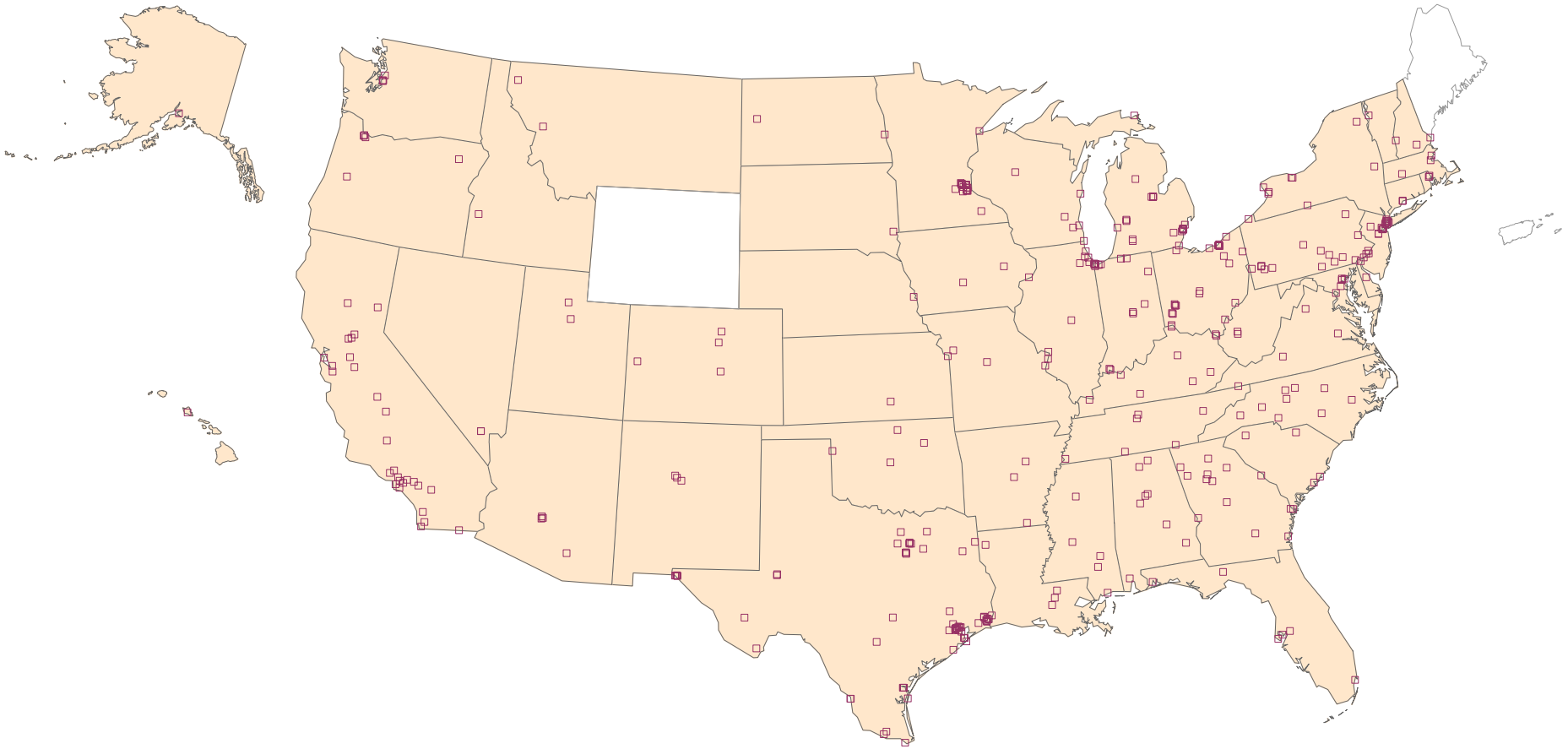
Meteorology

HAP Monitor Locator Map

United States

AirData

Shaded states have monitors



HAP Monitoring Site: □ (350)

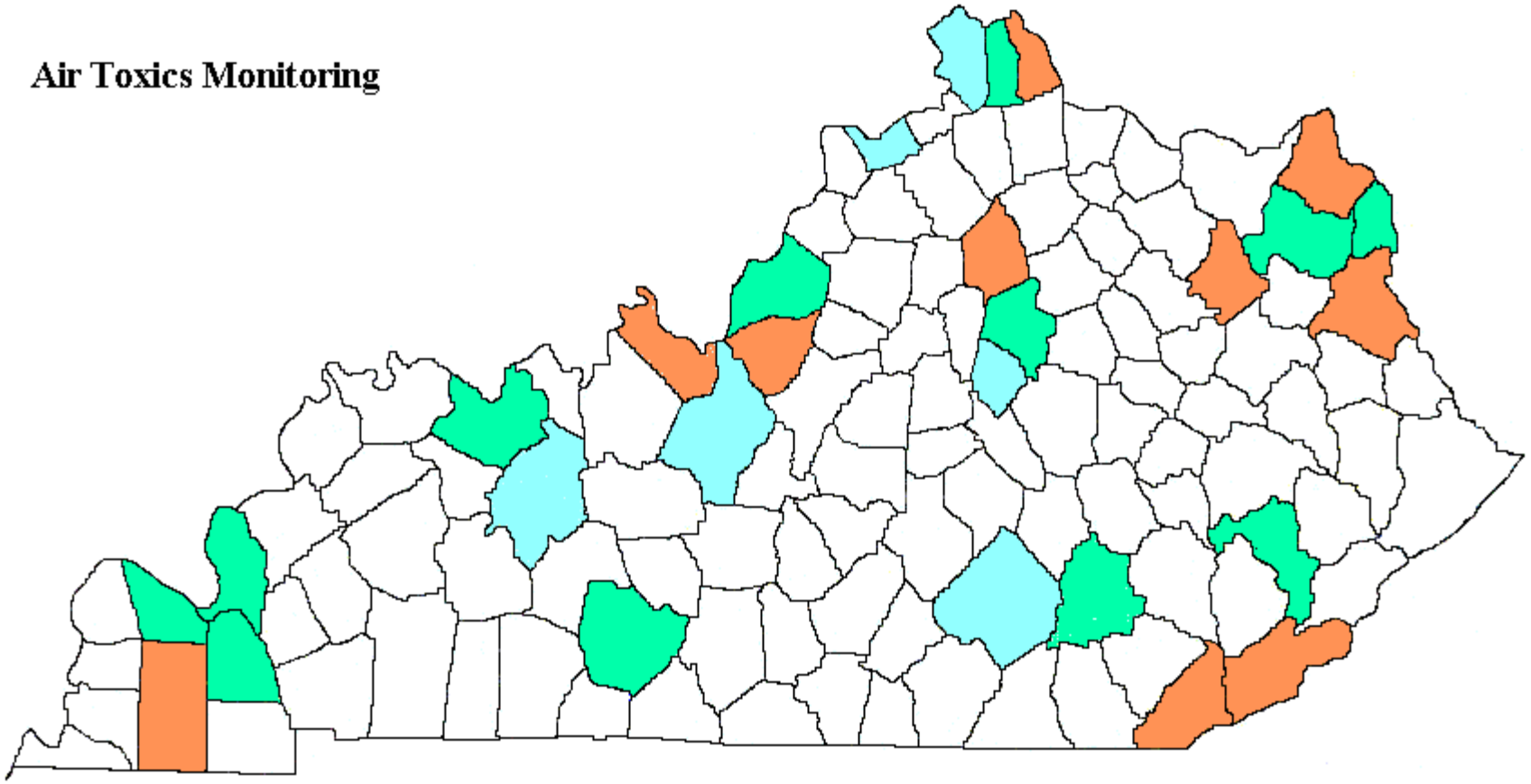
Source: US EPA Office of Air and Radiation, AQS Database

Wednesday, December 1, 2004

Current/Proposed Efforts

- Continue to operate 4 sites in Calvert City
- Continue to operate sites in Tri-State Area
- Resume sampling at Urban Trends Sites (5 sites total) (Lexington, Covington, Owensboro, Paducah, Bowling Green)
- Continue to operate Rural Trends site in Hazard
- Add site in Ohio County
- Add site(s) in Carroll/Gallatin Counties (2005)
- Add site in Hardin County (2005)
- Develop a Mercury monitoring network (2005)

Air Toxics Monitoring

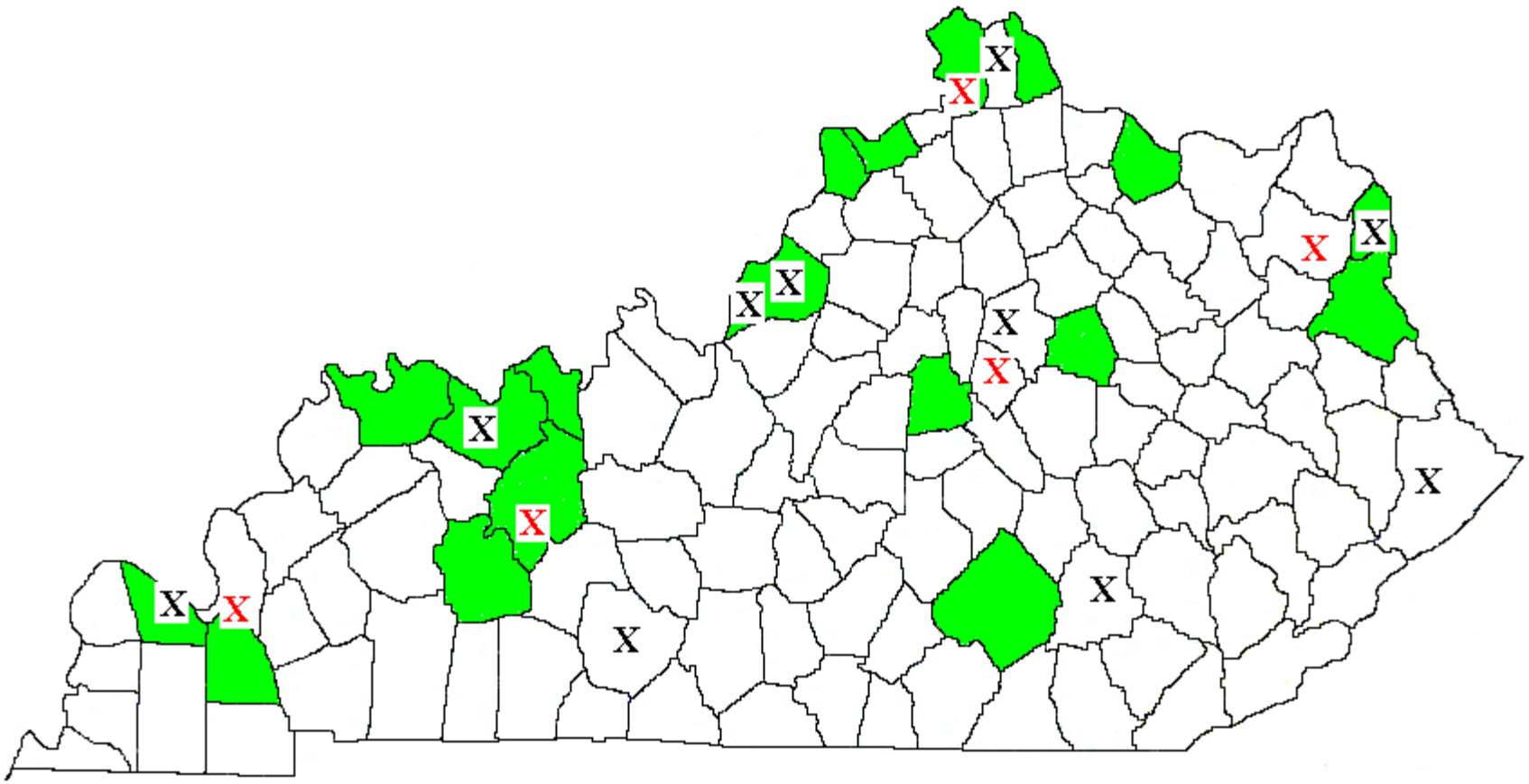


- Historical
- Proposed
- Active

Carroll County and Hardin County sites pending procurement of additional sampling equipment.

Mercury Sampling Network

2004-2005



X Sampling Tekran

X Sampling Speciation

Counties with Mercury Sources

Closing Thoughts

- 2002 Toxics Release Inventory listed over 61 million pounds of toxic air pollutants released in Kentucky from industrial sources
- New technologies will allow for easier and more cost effective sampling methods
- Need enhanced data processing capabilities
- Use of computer modeling to determine “Hot Spots” and chemicals of concern.